TNO-report

96-CMC-R0290

SHOCK TESTING OF A DRY CHEMICAL FIRE EXTINGUISHER inclusive a BRACKET

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Date: July 1996

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Department	: Naval Construction
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Appendix	

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MANAGEMENTUITTREKSEL

Titel : Shock testing of a dry chemical fire extinguisher inclusive a bracket.

Auteur : F.J. van Bragt

Datum : July 1996

Opdrachtnr. : 62376588 / A96/KM/126

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Rapportnr. : 96-CMC-R0290

De schokbestendigheid van een poederblusser, type PG9 - fabrikaat SAVAL, inclusief de ophangbeugel zijn experimenteel onderzocht.

De standaard ophangbeugel voor de poederblusser, is niet schokbestendig.
Samenwerking tussen fabrikant en het Ministerie van Defensie (Marine) resulteerde in een prototype-beugel die ter beproeving werd aangeboden.

Er zijn tijdens en na de beproevingen geen tekortkomingen aan de poederblusser geconstateerd.
De vergrendeling van de snelsluiting van de ophangbeugel functioneerde in één beproevingsrichting niet voldoende, waardoor de poederblusser uit de ophangbeugel werd gelanceerd.
Na een vrij simpele modificatie bleef de sluiting goed functioneren, ook na herhaalde schokproeven.

De beproefde poederblusser en de specifieke KM-beugel voldoen aan de gestelde schokeisen, mits de vergrendeling van de snelsluiting wordt gemodificeerd.

Contents

1. INTRODUCTION

By order of the Netherlands Ministry of Defence (Navy), a dry chemical fire extinguisher and a special bracket, type PG9 - make SAVAL, have been exposed to shock tests.

The shock tests have been performed by the "Centre for Mechanical Engineering" in Delft the Netherlands, on June 13th 1996.

The shock tests were carried out in accordance with the specification shock grade B(F).

The special KM bracket was engineered in close cooperation between the manufacturer and the Ministry of Defence (Navy).

The tests were conducted by F.J. van Bragt.

The shock tests were witnessed by T.S van Tongeren LTZT 1, Mr. T.H.Smits from the R.Nl.N, Mr. N.Albersen and K.Nooyens from SAVAL.

2. IDENTIFICATION OF THE EQUIPMENT

2.1.1 Equipment

Name : dry chemical fire extinguisher

Type : PG9

Mass [kg] : 15

NSN : 4210-17-056-3644

2.1.2

Name : bracket

Type : KM

Material : stainless steel 316

Mass [kg] : 3.9

Mounting : fixed with 6 bolts M12

2.2 Manufacturer and supplier

Name : SAVAL bv
Address Weststrik 17
P.O. Box 100
4840 AC Prinsenbeek
The Netherlands

2.3 Remarks

During the test in progress the safety belt snap lock failed.
Before the next shock tests a modification was carried out in the snap lock device.

3. SHOCK REFERENCE DATA

3.1 Shock requirements

Operating conditions : not applicable during the shock test

Shock directions : vertical, *perpendicular and *transverse

Shock grade : B(F)

* *The requirements in the perpendicular and transverse direction are lower than for the vertical direction. The equipment has been shock tested accordingly, so the mounting position on board of the ship shall always be upright.*

3.2 Shock testing machine

Type : light weight shock machine

Installed at : Centre for Mechanical Engineering

Address : Leeghwaterstraat 5
P.O. Box 29
2600 AA DELFT
The Netherlands
phone +31-152608408

4. SHOCK TEST SET UP

The fire extinguisher, mounted in the bracket, was fixed to an auxiliary structure which was rigidly mounted to the shock machine table. This is the normal mounting position on board of the ship (see figure 1).
For reasons of economy a second fire extinguisher was mounted on the auxiliary structure in the perpendicular and the transverse directions; in this way the positive and negative orientation were tested in one blow, (see figures 2 and 3).

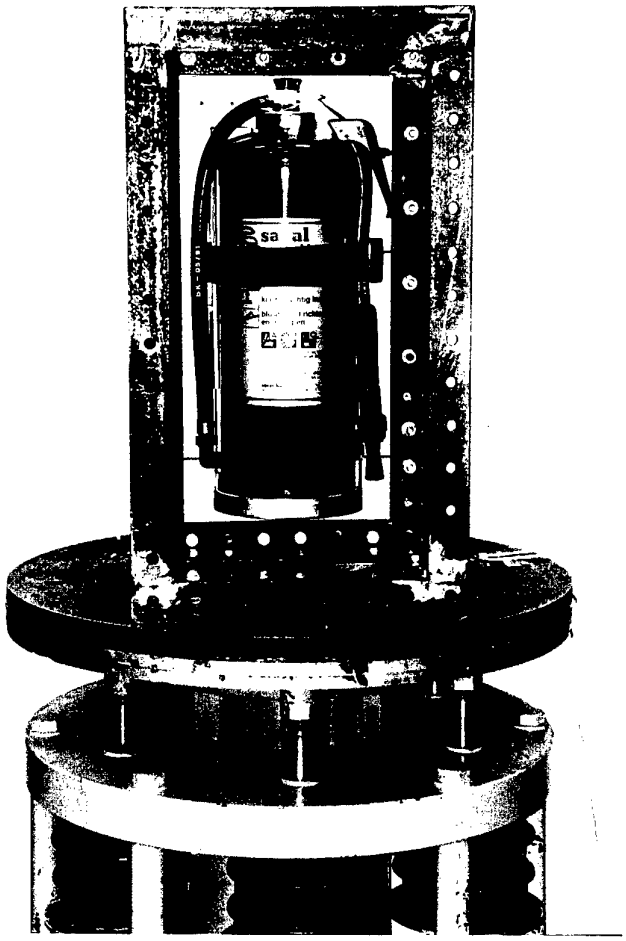


Figure 1, Fire extinguisher on test in the vertical direction (Z).

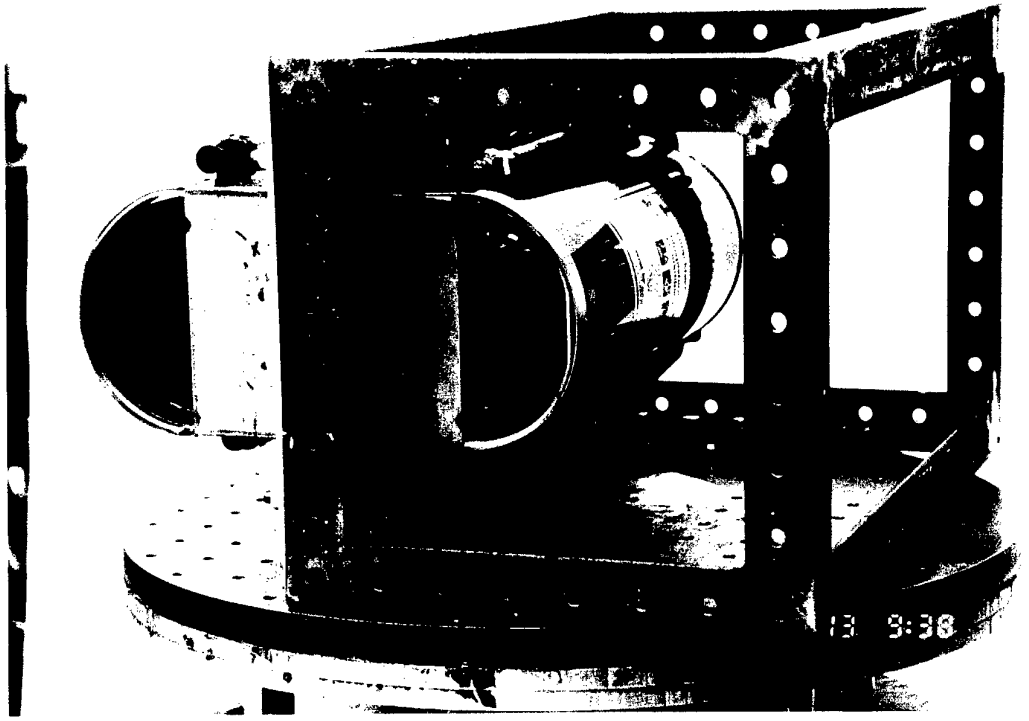


Figure 2, Fire extinguishers on test in the transverse direction (+ and -).

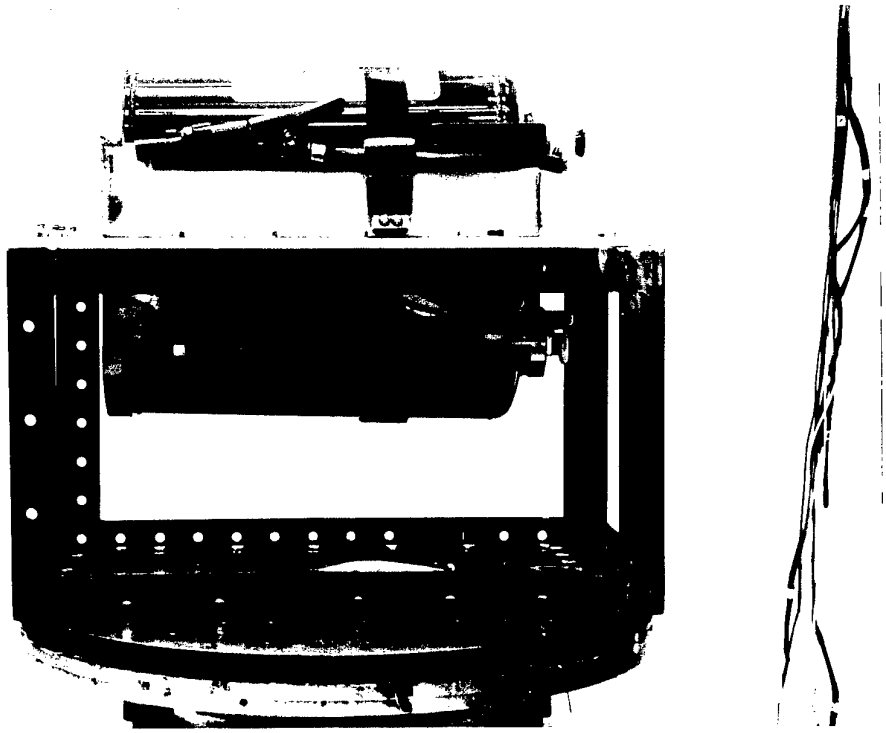


Figure 3, Fire extinguishers on test in the perpendicular direction (+ and -).

5. SHOCK TEST PROCEDURE

5.1. Shock simulator control

The shock machine can be set for different shock grades and shock level factors.
The shock grade is set according to the reference pulse and verified by means of the velocity signal of the simulated shock pulse.

The shock pulse on the shock machine table is measured by means of a piezoresistive accelerometer.

The shock pulse acceleration is digitized, stored in a computer memory, integrated to obtain pulse velocity and double integrated to obtain pulse displacement.
From the acceleration signal the maximax shock response spectrum, in terms of pseudo velocity, is calculated over the frequency range 5 - 1000 Hz for a damping factor of 0.01.

The relevant data of the shock tests have been tabulated in the tables of Ch. 7.

The graphical representation is given in Ch. 8 as information only.
No claims can be derived from this information.

6. SHOCK INSTRUMENTATION AND DATA HANDLING

6.1 Transducer locations

For verification of the applied shock with the requirement, acceleration measurements were performed on the table of the shock machine.

6.2 Shock instrumentation

The measuring system consisted of:

* Accelerometers; type 2262/1000; manufacturer Endevco.
  The last calibration of the accelerometers was carried out in May 1996.

* Programmable High Speed Data Acquisition System.
  Type SCADAS 212; serial no: 80904002; Manufacturer DIFA.
  Calibrated July 1995; due July 1996.

* Personal Computer T3200 SXC.
  DMA interface.
  D_TAC software. Manufacturer DIFA.

A block diagram of the hardware and the software can be found in figure 4.

6.3 Relevant shock instrumentation settings

Block size	: 8192
Sample frequency	: 10 kHz
Filter frequency	: 2 kHz (Equal time delay filters)

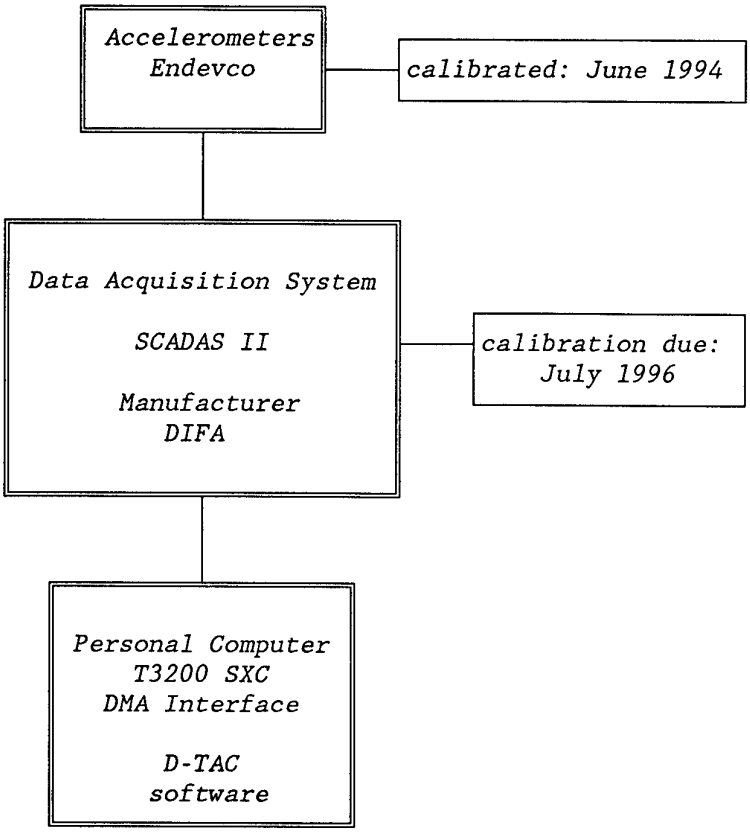


Figure 4, Shock measurement system

7. TEST RESULTS

The data measured during the tests are tabulated below.

Shock id.no.		01	02	03
shock direction	*)	**Z**	**Z**	**Z**
acceleration	[m/s²]	1178	2140	3260
deceleration	[m/s²]	325	595	921
velocity	[m/s]	2.0	4.2	6.0
displacement	[mm]	15	32	44
time T1	[ms]	4.3	4.0	4.2
time T2	[ms]	31	35	33
page		–	–	13
date of test			June 13th	

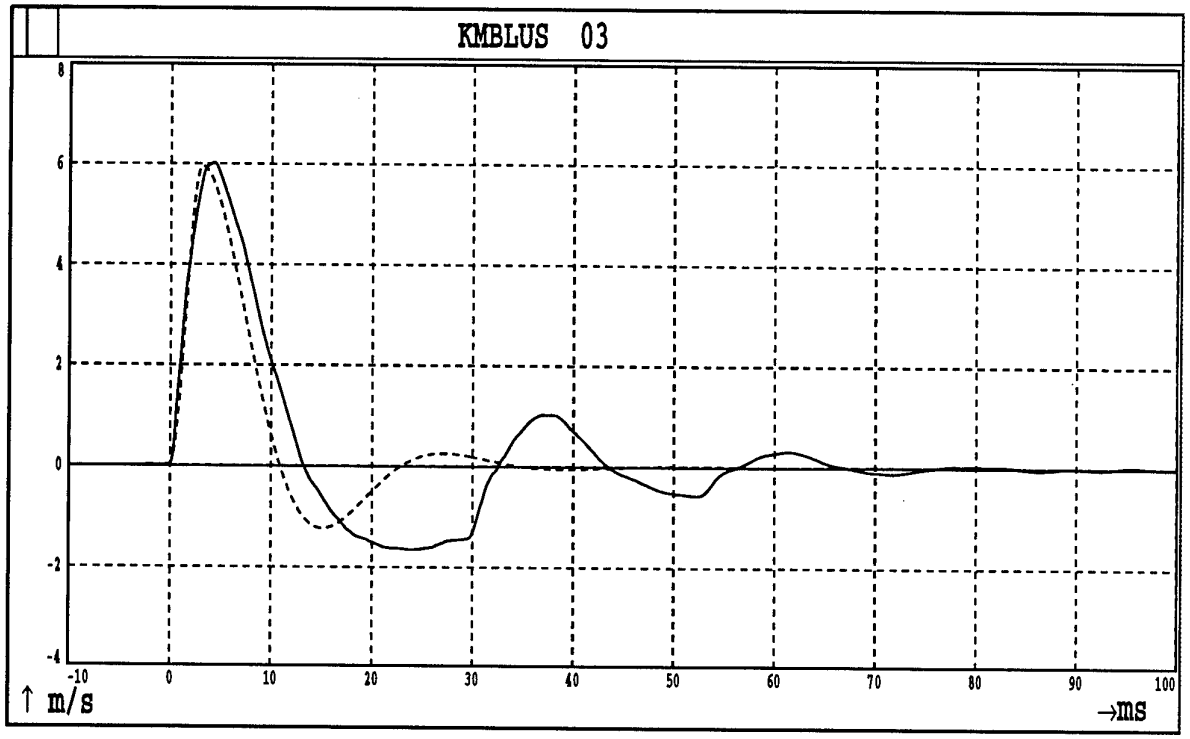
Shock id.no.		04	05	06	07	08
shock direction	*)	**X**	**X**	**X**	**X**	**Y**
acceleration	[m/s²]	1594	1950	2110	2200	1795
deceleration	[m/s²]	440	630	548	650	650
velocity	[m/s]	2.7	3.3	3.3	3.3	3.1
displacement	[mm]	19	23	22	22	22
time T1	[ms]	4.1	3.9	4.0	3.9	3,1
time T2	[ms]	33	32	32	32	33
page		–	–	–	14	15
date of test				June 13th		

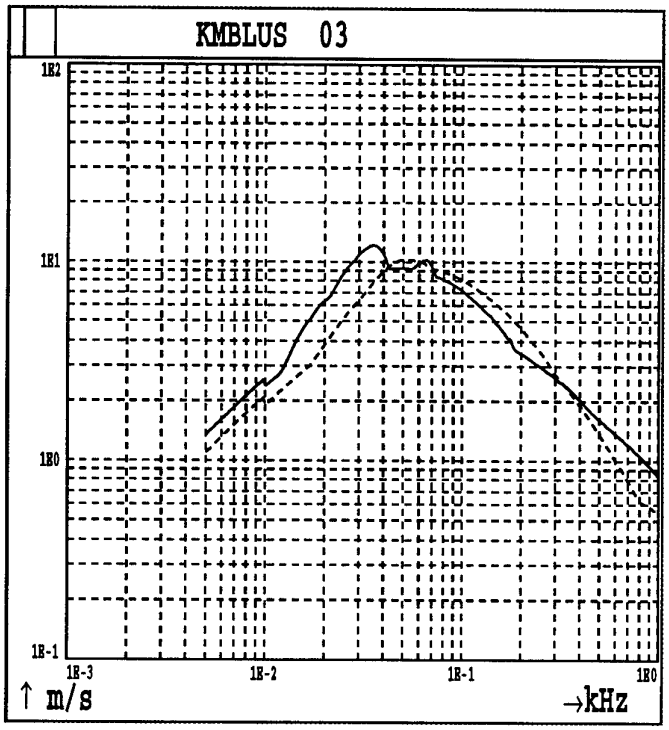
*) Z = vertical test direction;
X = transverse test direction
Y = perpendicular test direction

8. GRAPHICS PRESENTATION

The figures 5,6 and 7 show the shock results at maximum intensity in each test direction.

In each figure the velocity time history and the maximax pseudo velocity shock response spectrum are presented. In each of the graphs the motion measured at the table, as well as the requirement are given.

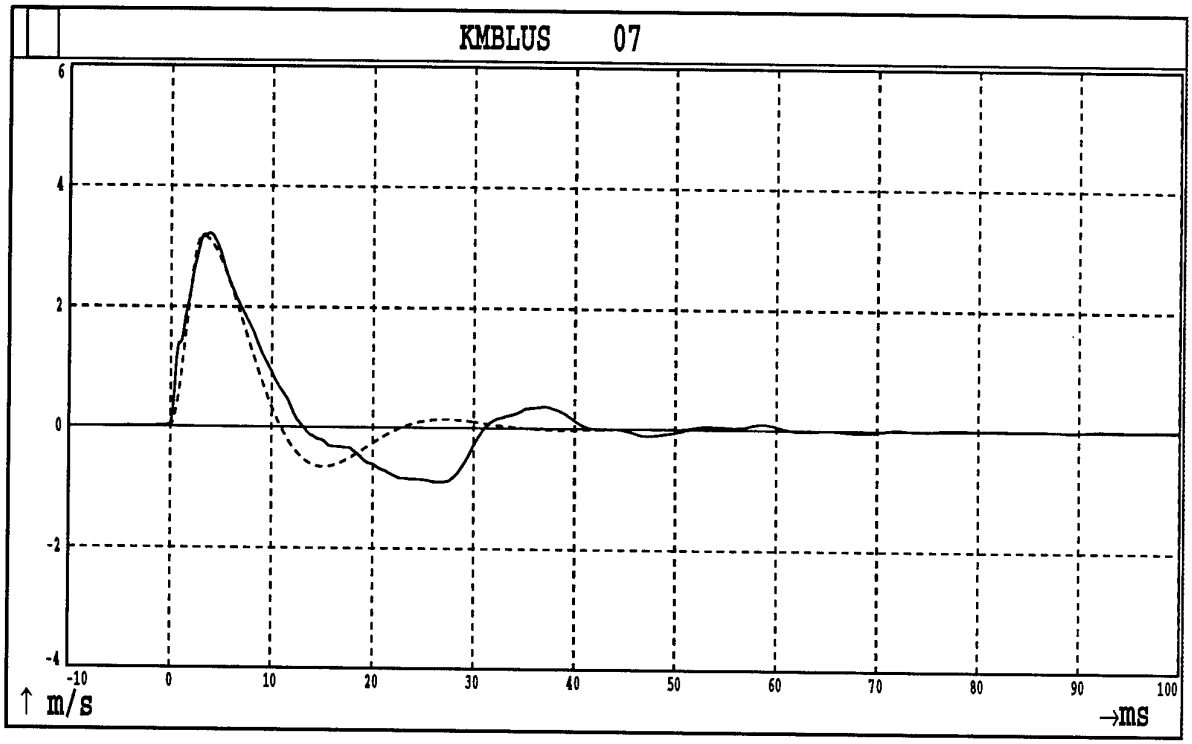


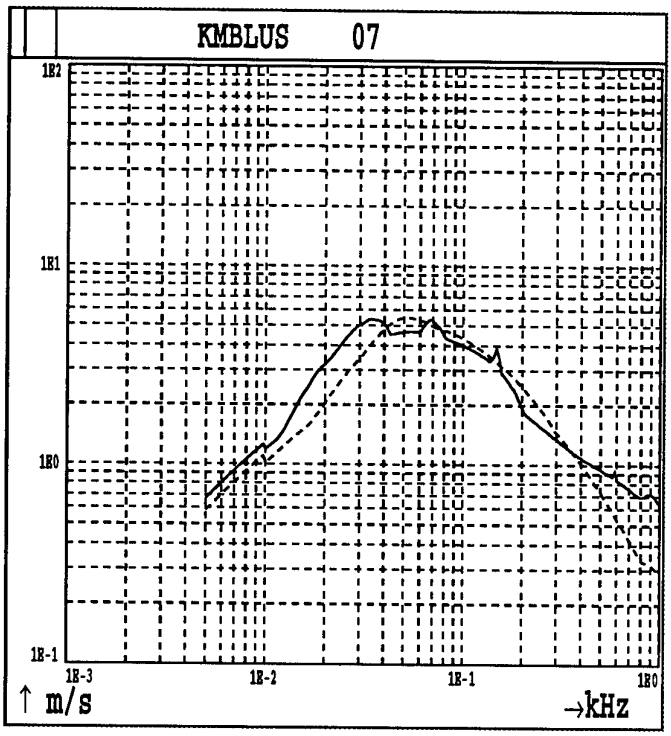


- - - - - - - - - requirement B(F)

——————— shock machine table

Figure 5, Vertical test orientation.

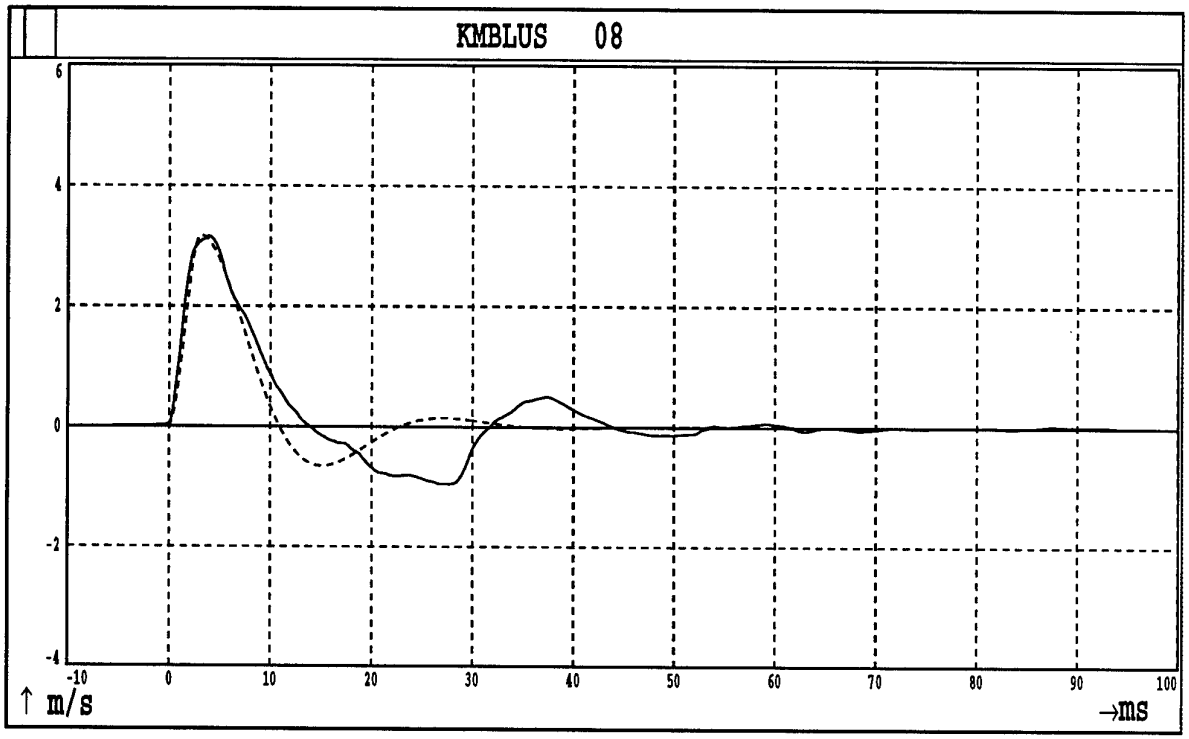


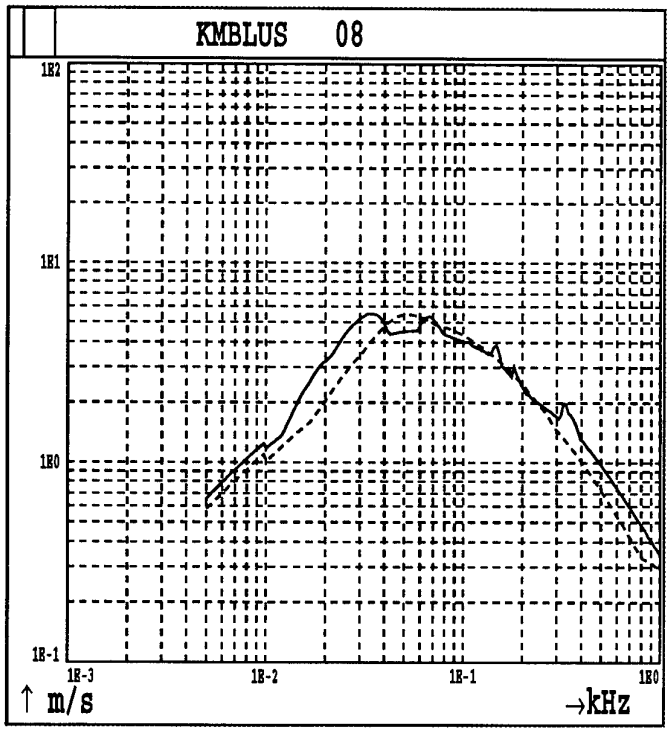


- - - - - - - - - requirement B(F)

——————— shock machine table

Figure 6, Transverse test orientation.





- - - - - - - - -
requirement B(F)

shock machine table

Figure 7, Perpendicular test orientation.

9. INSPECTION REPORT

9.1 Test results

The results of the tests are presented in the table below.

Shock	Direction	Remarks
01	vertical (Z)	Satisfactory result.
02	vertical (Z)	Some minor deformation was observed at the top right side of the bracket. Satisfactory result. *note: due to the deceleration phase in the motion the bottle can move, more or less freely, in upward direction and hit the upper structure of the bracket.*
03	vertical (Z)	The rubber strips at the base of the bracket were cut in by the fire extinguisher base. A minor deformation was also observed at the base of the bracket. Satisfactory result.
04	transverse (X)	Minor deformation at the bracket base. Satisfactory result.
05	transverse (X)	The snap lock of the safety belt failed for the test with the bracket in the -X-orientation. As a result the fire extinguisher came out of the bracket. The lock device was opened and showed a leaf spring to keep the lock under tension, (figure 8). Obvious the spring stiffness was not enough to keep the lock in place during the shock test. The fire extinguisher, which was tested in the +X-orientation was in good order.
06	transverse (X)	An additional piece of rubber was placed between the steel spring and the lock cover to increase the stiffness (figure 9). The previous test was repeated with the modified lock (-X) and the original lock (+X). Both safety belt locks were in good order. Satisfactory result.
07	transverse (X)	For optimization the size of the rubber piece was reduced (figure 10). The shock test was repeated, showing no failures in the locks. Quite some deformation was observed with the bracket base after the four tests in the X-direction, (see figure 11). Satisfactory result.
08	perpendicular (Y)	Satisfactory result.

After completion of the shock tests the riser pipe was inspected and proved to be undamaged.

A functional test and inspections were carried out by the manufacturer, see appendix.

9.2 Functional inspections

The inspections were carried out by:

Centre for Mechanical Engineering	; name:	F.J. van Bragt
Ministry of Defense (PFS/MMT)	; name:	T.S. van Tongeren LTZT 1
Ministry of Defense	; name:	T.H. Smits
SAVAL	; name:	N.Albersen
		K.Nooyens

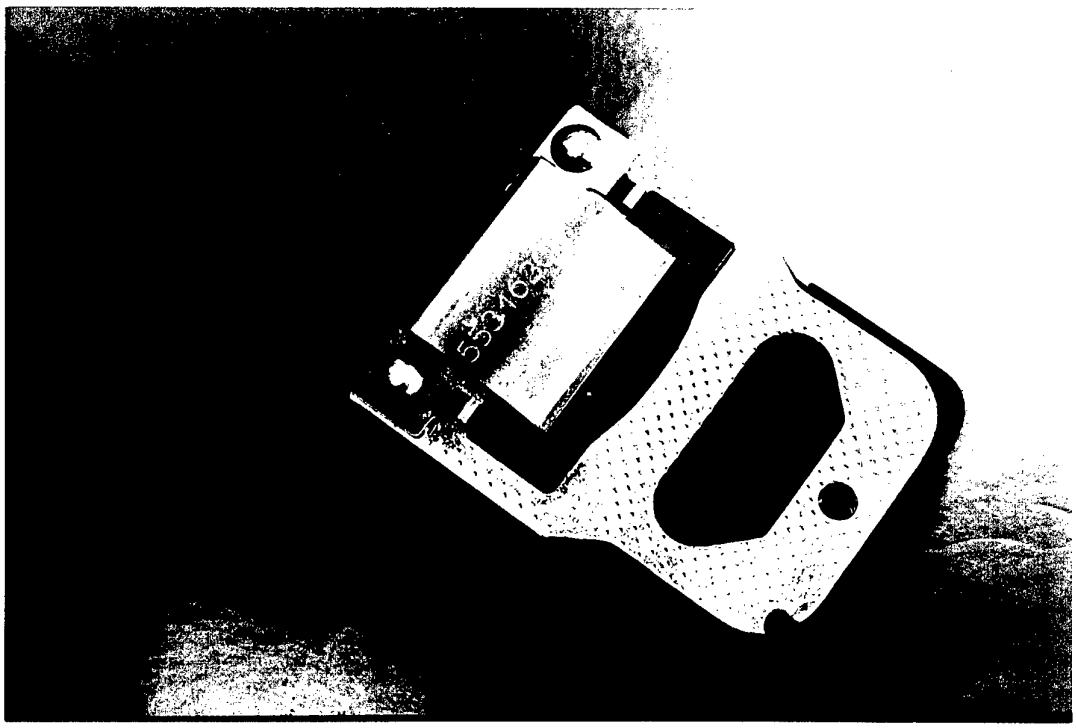


Figure 8, Original snap lock of the safety belt, (note: the cover has been removed).

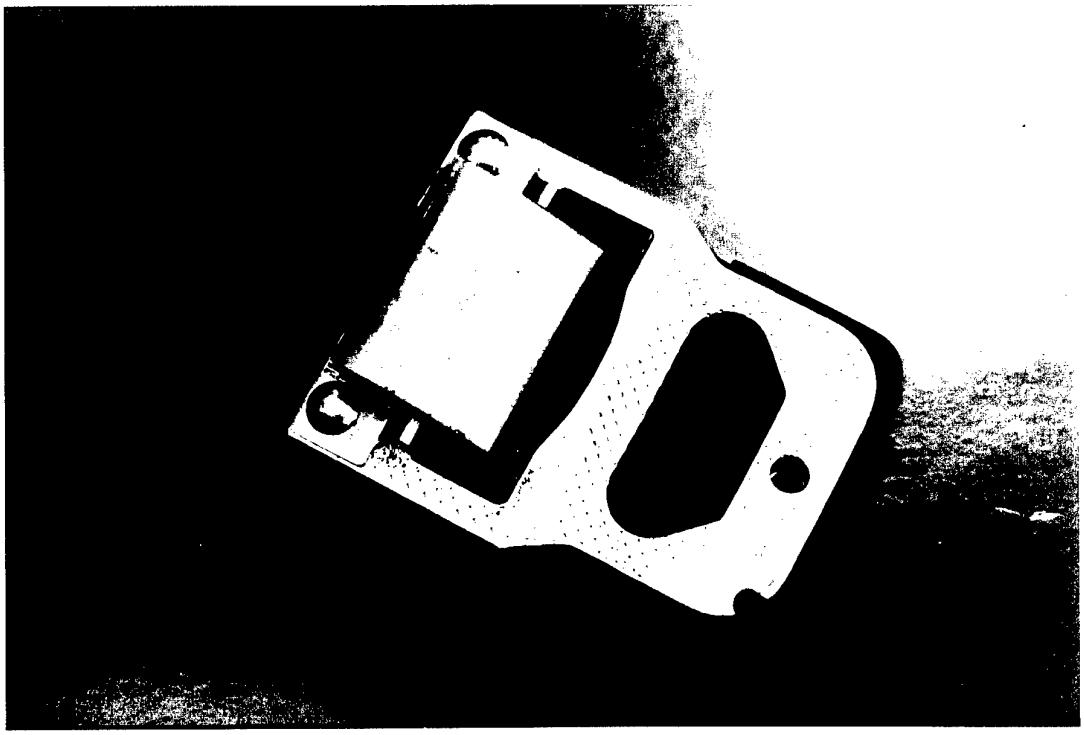


Figure 9, A piece of rubber has been placed on the spring, filling up the gap between the spring and the cover.

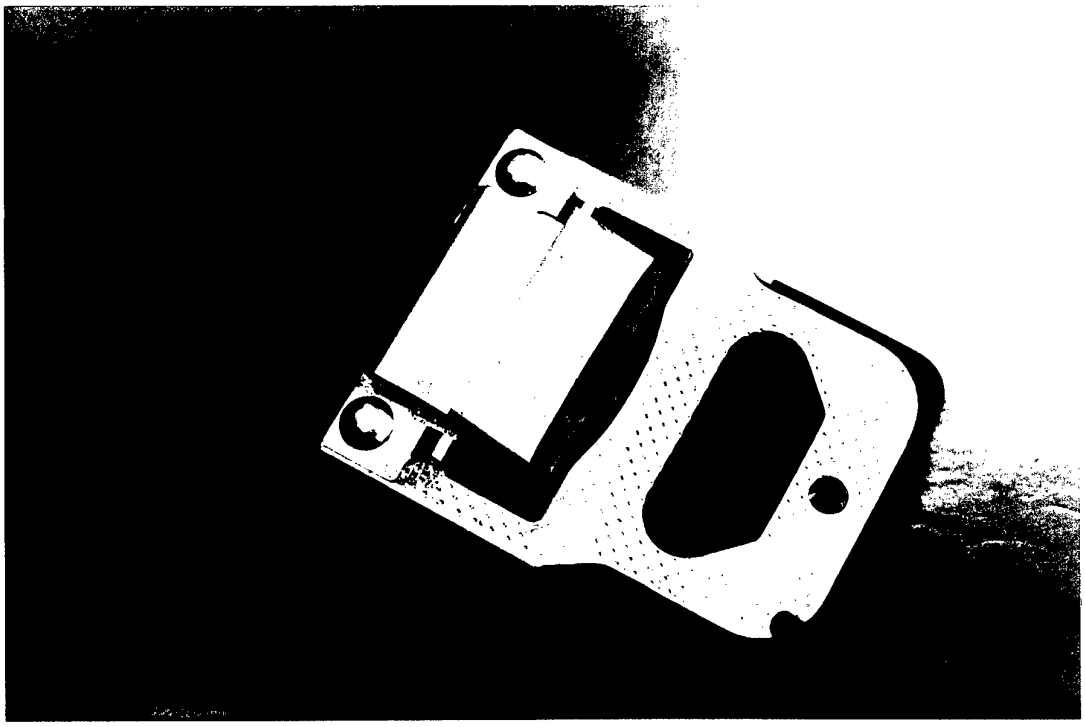


Figure 10, A smaller piece of rubber has been placed on the spring, filling up the gap between the spring and the cover.

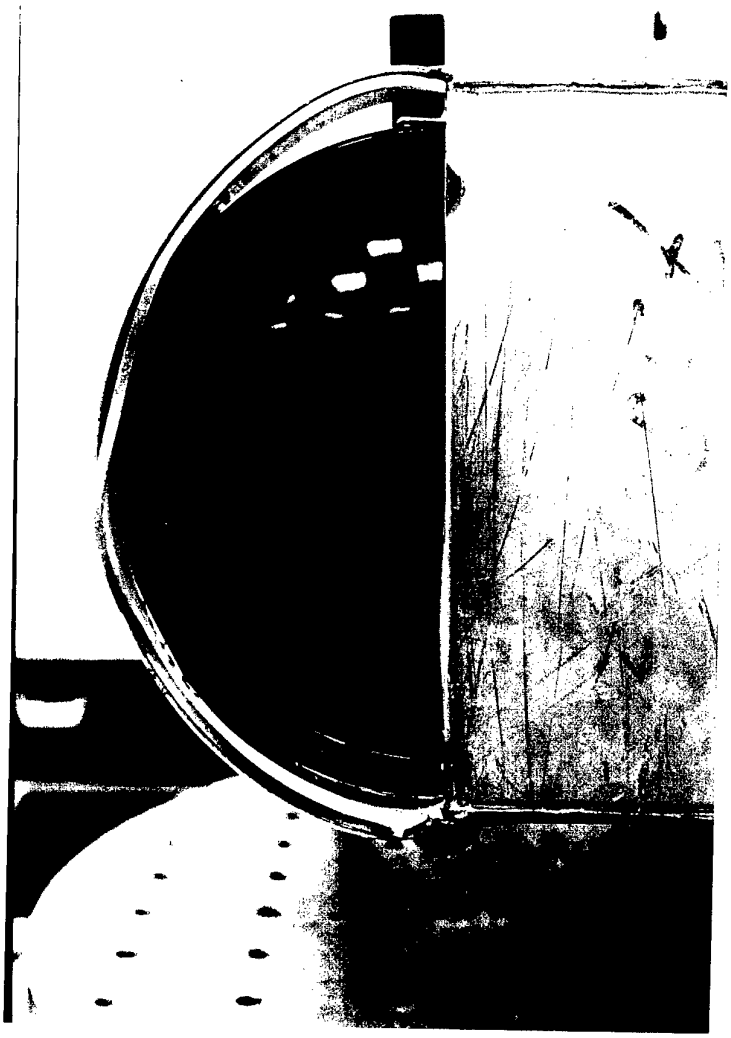


Figure 11, Deformed bracket base support.

10. CONCLUSION

The tested dry chemical fire extinguisher, type PG9, inclusive the bracket and the modified snap lock sustained the shock tests satisfactorily and meet the given shock requirements.

TEST-CERTIFICAAT

TEST-ONDERWERP	:	Visuele inspectie Poederblusser ná uitvoering 300g-test marinebeugel
PROJEKT	:	Testen van schokbeugels PG9 tbv Marine bij TNO-Delft
BEDRIJF	:	Koninklijke Marine Den Haag Afd.Platform-systemen
KONTRAKTOR/INKOPER	:	Ministerie van Defensie Koninklijke Marine
ADRES	:	v.d. Burchlaan 31
PLAATS	:	Den Haag
KONTAKT	:	Dhr. T. van Tongeren
KONTRAKT	:	nvt
SUB-KONTRAKTOR	:	SAVAL B.V.
ADRES	:	Postbus 100, Prinsenbeek, Nederland
INKOOPORDER	:	nvt
SYSTEEM/PRODUKT	:	9Kg PG-Poederblusser
AANTAL	:	2

TEST-RESULTAAT :

Onderzocht:	Blusser 1:	Blusser 2:
Patroon	In orde	In orde
Inslagknop	"	"
Binnenbus	"	"
Romp	"	"
Pistool	"	"
Poeder(vloeibaarheid)	"	"
Slang	"	Mechanische beschadiging (boven Wartel)

VOOR AKKOORD

QA-Inspecteur Saval B.V.	**Naam**	: **D. Nieto**
	Stempel/datum	: **01-07-96**
	Ondertekening	:
Projektmanager Saval B.V.	**Naam**	: **N. Albersen**
	Ondertekening	:
QA-Vertegenwoordiger Kontraktor/Inkoper	**Naam**	:
	Stempel/datum	:
	Ondertekening	:

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Shock testing of a dry chemical fire extinguisher, type PG9, inclusive special bracket.
Manufacturer: SAVAL

11. Author(s)
F.J. van Bragt

12. Performing organization name(s) and address(es)
Centre for Mechanical Engineering
Leeghwaterstraat 5 2628 CA DELFT, The Netherlands

13. Sponsoring/Monitoring agency name(s) and address(es)
Netherlands Ministry of Defence (Navy); Naval Construction; P.O.Box 20702; 2500 ES 's-Gravenhage.
TNO Division of National Defence Research; P.O.Box 6006, 2600 JA Delft, The Netherlands

14. Supplementary notes
Centre for Mechanical Engineering is part of TNO Building and Construction Research

15. Abstract (Maximum 200 words, 1044 byte)
A dry chemical fire extinguisher and a special bracket, make SAVAL, have been exposed to shock tests. Failure was ascertained with the snap lock belt mechanism. After modification the lock mechanism proved to be working satisfactorily. The shock tests were carried out in accordance with the specification shock grade B(F). The tested dry chemical fire extinguisher inclusive bracket and modified lock meets the given shock requirements.

16. Descriptors	Identifiers
Warship	Damage
Shock and vibration tests	Surface ship
Underwater explosion	Fire fighting

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